

# **Deep Mapping the Reducción: Building a Platform for Spatial Humanities Collaboration on the General Resettlement of Indians in the Viceroyalty of Peru**

Steven A. Wernke, PI/Project Director  
Jeremy R. Mumford, co-PI/Project Co-Director

Final White Paper

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## Title page

### Final Performance Report National Endowment for the Humanities

Type of Report: Final white paper

Grant Number: **HD-229071-15** Digital Humanities Startup Grant, Level 2

Project Title: Deep Mapping the Reducción: Building a Platform for Spatial Humanities  
Collaboration on the General Resettlement of Indians in the Viceroyalty of Peru

Project Director: Steven A. Wernke, Associate Professor, Vanderbilt University

Project Co-Director: Jeremy R. Mumford, Assistant Professor, Brown University

Date: 5/3/2018

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### **Narrative Description**

#### ***a. Project Activities***

The goal of this project was to develop two online collaborative tools to enable a global perspective on one of the largest forced resettlement programs ever undertaken by a colonial power: the *Reducción General de Indios* (General Resettlement of Indians) of the late sixteenth century in the viceroyalty of Peru.

The two tools are *LOGAR: Linked Online Gazetteer of the Andean Region*, and *GeoPACHA: Geospatial Platform for Andean Colonial History, Culture, and Archaeology*. The two tools were developed as a complementary platform for collaborative research: *LOGAR* was designed to enable the compiling and collation of information (primarily archival source documentary materials, though extensible to ethnographic, archaeological, and other types) by *place* through stable *place pages*, using a linked open online gazetteer framework. *GeoPACHA* was designed as a discovery instrument—as a browser-based geospatial platform (Geographic Information System) that enables “virtual archaeological survey” to locate previously undocumented colonial places in the Viceroyalty of Peru.

To date, both have focused on locating and collating information on the planned colonial towns (referred to as *reducciones* or “reduction towns”) established during the General Resettlement of the 1570s. In global historical terms, the General Resettlement is important as one of the largest forced resettlement programs ever undertaken by a colonial power. Over 1.4 million native Andeans were forcibly resettled into over 1,000 *reducciones* as part of the General Resettlement. The demographic, political, economic, religious, and social effects of the *Reducción* reverberate to the present. It exacerbated the transmission of infectious disease, provoking successive waves of population losses. It displaced communities away from their agricultural and pastoral resources, triggering the abandonment of colossal swaths of human-engineered landscapes throughout the Andean region. It intervened in the most intimately held beliefs and practices regarding the ordering of the world through the intercession of Catholicism in daily life. And it reworked the basic routines of daily life. Many Andean communities continue to live in these *reducción* towns. Others were abandoned. But the basic parameters of the resettlement remain largely obscure, because no comprehensive source exists as to their locations, and extant sources about their long term histories are fragmentary and dispersed. Accordingly, scholarship on the subject has tended toward the local to regional in scale. Progress toward a global view of the General Resettlement as a whole has been hindered by the fragmentary nature of the sources and scholarship.

*LOGAR* and *GeoPACHA* were designed to overcome this fragmentation of sources and knowledge. Development was further supported by two fellowships awarded to Wernke: a Mellon Faculty Fellowship at the Vanderbilt University Center for Digital Humanities (July, 2016-July, 2017, 10,000 plus one course release), and a Vanderbilt University Chancellor’s Faculty Fellowship (two years [July, 2016-July, 2018], \$40,000/year). This additional support enabled two course buyouts, salary for a research assistant, and direct support of development. This project benefitted from the collaborative structure provided by a series of international symposia co-organized by Wernke and Akira Saito (Professor, National Museum of Ethnology,

Japan). These symposia were financed through a five year grant to Dr. Saito from the Japan Society for the Promotion of Science, with additional funding by the College of Arts and Science, Vanderbilt University, as part of an Institutional Agreement between Vanderbilt and the National Museum of Ethnology, Japan. Three symposia were held over the course of the grant period: two at Vanderbilt, and one in La Paz, Bolivia. These symposia brought together leading experts on the General Resettlement, and acted as ideal platforms for collaboration and for soliciting feedback from the research community regarding the design and features of *LOGAR* and *GeoPACHA*. Dr. Saito also generously provided full scanned copies of the four archival manuscripts of the summary ledger (tasa) of the Visita General—the most comprehensive listings of reducción towns in existence. During the next implementation phases of *LOGAR*, Dr. Saito will take over the role of co-editor, as Dr. Mumford is stepping down from that role.

A summary timeline of major project activities is presented below, followed by discussion of the development of *LOGAR* and *GeoPACHA*, with reference to how their development was originally proposed.

### *Project Activities Timeline*

<b><i>Dates</i></b>	<b><i>Activities</i></b>
<i>May - November, 2015</i>	Development of working prototype of <i>LOGAR</i> , initial launch on development server
<i>November 6 - 8, 2015</i>	Conference presentation: “Deep Mapping the Reducción: Building a Platform for Spatial Humanities Collaboration on the General Resttlement of Indians in the Viceroyalty of Peru,” by Steven A. Wernke and Jeremy Ravi Mumford. Paper to be presented at the international symposium Rethinking Forced Resettlement in the Colonial Andes, organized by Akira Saito and Steven A. Wernke, sponsored by the National Museum of Ethnology, Japan, hosted by Vanderbilt University (November 6-8, 2015).
<i>December, 2015 - April, 2016</i>	Proofing and additional place locations in <i>LOGAR</i> , release on production server
<i>February, 2016</i>	Invited presentation: "2016 Deep Mapping the Reducción: Building Digital Humanities Collaborative Tools for Mapping the General Resettlement of Indians in the Viceroyalty of Peru," by Steven A. Wernke and Jeremy R. Mumford. Invited lecture presented at the Research Institute for Humanity and Nature, Kyoto, Japan.
<i>June, 2016</i>	Invited presentation: “ <i>LOGAR</i> y <i>GeoPACHA</i> : avances en el desarrollo de herramientas digitales colaborativas para la investigación del mundo andino colonial”, by Steven A. Wernke and Parker VanValkenburgh. Paper presented at the international symposium Las reducciones toledanas en perspectiva comparativa y multidisciplinaria, organized by Akira Saito, National Museum of Ethnography and Folklore, La Paz, Bolivia.
<i>June, 2016 - December 2016</i>	Researching codebase architecture/wireframing <i>GeoPACHA</i>
<i>July, 2016 - July, 2017</i>	Mellon Faculty Fellowship, Center for Digital Humanities, Vanderbilt University (Wernke)
<i>July, 2016 - July, 2018</i>	Chancellor's Faculty Fellowship, Vanderbilt University (Wernke)
<i>November, 2016</i>	Submission of CAST SPARC grant proposal (Wernke, VanValkenburgh)
<i>February, 2017</i>	CAST SPARC grant award notification (Wernke, VanValkenburgh)
<i>April, 2017</i>	Request for one year no cost extension (paternity leave, Mumford)

April, 2017 - October, 2017	Development and launch of <i>GeoPACHA</i>
October-December, 2017	<i>GeoPACHA</i> testing, <i>LOGAR</i> database expansion to 523 located reducciones
January, 2018	Submission of ACLS Digital Extension Grant proposal (Wernke, VanValkenburgh): Extending <i>GeoPACHA</i> : Geospatial Platform for Andean Culture, History, and Archaeology
January, 2018	Submission of NEH ODH Level III Digital Humanities Advancement Grant: Implementing <i>GeoPACHA</i> : Geospatial Platform for Andean Culture, History, and Archaeology
May, 2018	Award of ACLS Digital Extension Grant (to begin December, 2018)

### *LOGAR development*

The project was designed to begin with development and initial database construction of *LOGAR* first, followed by development of *GeoPACHA*, and a final period of refinement and launch of both. As proposed, we developed *LOGAR* using the codebase of another NEH ODH-funded gazetteer—the Syriac Gazetteer ([www.syriaca.org](http://www.syriaca.org)). The lead programmer for *LOGAR*, Winona Salesky, also developed the Syriac Gazetteer codebase, and was most effectively able to adapt it to suit our purposes. As proposed, all development for *LOGAR* was performed online via GitHub (<https://github.com/LOGARANDES>). The entire codebase is available for reuse, remixing, or repurposing, under CC-BY Creative Commons licensing (free and open reuse, with attribution).

Working with Salesky, we developed a working prototype of *LOGAR* the end of November, 2015—six months after the start of the project and ahead of the timeline proposed (see interim report 1). We established a development server and production server, and we continue to use these environments for ongoing development.

In tandem with the development of *LOGAR* architecture, we prepared an initial dataset of the locations of reducción towns. This required the collective efforts of our team from November 2015 through April, 2016, resulting in an initial database of 488 reducción town locations, cross-referenced to archival source information on each, derived from one of three extant fragments of the summary ledger of the General Resettlement currently known to have survived in the archival corpus. Town locations were identified by searching for them in satellite imagery using Google Earth, Google Maps, and QGIS. For this aspect, Wernke developed (during October, 2015) a customized GIS (using QGIS connected to a PostGreSQL/POSTGIS database) that was distributed to project participants. This functioned as a means of tracking progress of reducción town identifications, as well as a variety of additional attributes with each identification (e.g. confidence ranking [0-4], notes, etc) with an attribute form. After the compilation of the information between November 2015 and April, 2016, the dataset was then exported as comma separated value file for ingestion to *LOGAR* via XQUERY. With this initial pulse of data, *LOGAR* was launched in April. The database has since grown to 523 located reducción towns.

Each of the functions of *LOGAR* is described and illustrated in “Accomplishments” below. *LOGAR* continues under active development, intensification (addition of primary source materials by place) and extensification (addition of new places via crowdsourcing), supported through Wernke and ValValkenburgh’s startup funds.

### *GeoPACHA development*

Development of *GeoPACHA* followed the release of *LOGAR*, with a period of specification and wireframing during fall, 2016. For the development of *GeoPACHA*, Wernke

formed a collaboration with another Andeanist archaeologist, Parker VanValkenburgh (Assistant Professor of Anthropology, Brown University). After surveying comparable tools from other world regions, we identified the CORONA Atlas of the Middle East (<http://corona.cast.uark.edu/>), a project directed by Jesse Casana (Dartmouth College) and Jackson Cothren (Director, [Center for Advanced Spatial Technologies](#) [CAST], University of Arkansas) as a cognate tool. The CORONA Atlas was developed through CAST. Wernke and VanValkenburgh submitted a proposal to CAST's NSF-funded Spatial Archaeometry Research Collaboration (SPARC) grant program, to request an in-kind grant of developer time for adapting the CORONA codebase for *GeoPACHA*. Our SPARC grant proposal was awarded (with a cash equivalent value of approximately \$15,000).

Working with John Wilson, Director of Technology at CAST, *GeoPACHA* development proceeded through the summer and early fall of 2017. As proposed, *GeoPACHA* enables virtual archaeological survey through visual scanning of high resolution satellite imagery (via Google Maps satellite API), editorial review, and survey coverage tracking. The functionality of *GeoPACHA* is described in the Accomplishments section below. It is composed of an open source software stack, with MySQL, Javascript, and PHP (in the CodeIgniter framework). It is currently hosted on the CAST server at <https://GeoPACHA.cast.uark.edu/> and resides behind an authorized user firewall. These aspects are not as proposed. In the project proposal, we envisioned releasing *GeoPACHA* for general access by the end of the grant period, and to have its codebase hosted on GitHub. The reason for restricting access to authorized users at this stage is twofold: 1) the archaeological settlements identified require further review before release, and 2) the platform is functional but not yet fully tested and validated. As regards access to the codebase: it will be hosted on GitHub with open access in early 2019. It currently resides on CAST servers, in conformance with CAST development policies. With support from a American Council of Learned Societies Digital Extension Grant, we will transfer the codebase to GitHub in early 2019.

Transfer of the *GeoPACHA* codebase, with documentation, is among the first tasks to be completed with that implementation-scale grant. During development and testing of *GeoPACHA*, it became clear that its utility extended well beyond the discovery of abandoned colonial era reducción towns. The architecture of *GeoPACHA* is inherently extensible to other time periods, and can incorporate other imagery and legacy survey datasets. Accordingly, Wernke and VanValkenburgh prepared proposals for an American Council of Learned Societies Digital Extension Grant and an NEH ODH Level III Digital Humanities Advancement Grant. The ACLS Extension Grant was awarded (\$146,000), and we await the decision on the the NEH ODH proposal.

## **b. Accomplishments**

The project proposal goals were to produce working beta versions of *LOGAR* and *GeoPACHA*, and using them in collaboration with a network of contributing colleagues, establish the most comprehensive basemap of the General Resettlement of Indians in the Viceroyalty of Peru. We have met and exceeded these goals. Both *LOGAR* (<http://LOGARandes.org>) and *GeoPACHA* (<https://GeoPACHA.cast.uark.edu>) are online, and the project has compiled the most comprehensive basemap of the General Resettlement to date. *LOGAR* hosts 858 reducción towns as place pages, 523 of which are located. All include reference information for one of the three manuscript fragments of the master list (summary ledger, or *tasa*) of the General Resettlement. The total number of reducción towns documented in the four tasa manuscripts is 887. Thus,

*LOGAR* and *GeoPACHA* have identified the locations of 59% of the reducción towns in the *tasas*, and 97% of the reducciones in the *tasas* have place pages in *LOGAR*. This compilation of data was made possible by the simple user interface of these tools, and the collaborative efforts of our multidisciplinary, international collaborators. A summary of *LOGAR* and *GeoPACHA* capabilities and results are presented in turn below.

*LOGAR accomplishments*

With 858 reducción place pages, and 523 located reducciones in its database, *LOGAR* represents the most comprehensive map and archival source reference on the General Resettlement of Indians in the Viceroyalty of Peru (see Figure 1). With this extensive database and simple user interface in place, *LOGAR* will continue to deepen with user contributions on each place, and extend through virtual archaeological survey via *GeoPACHA*.

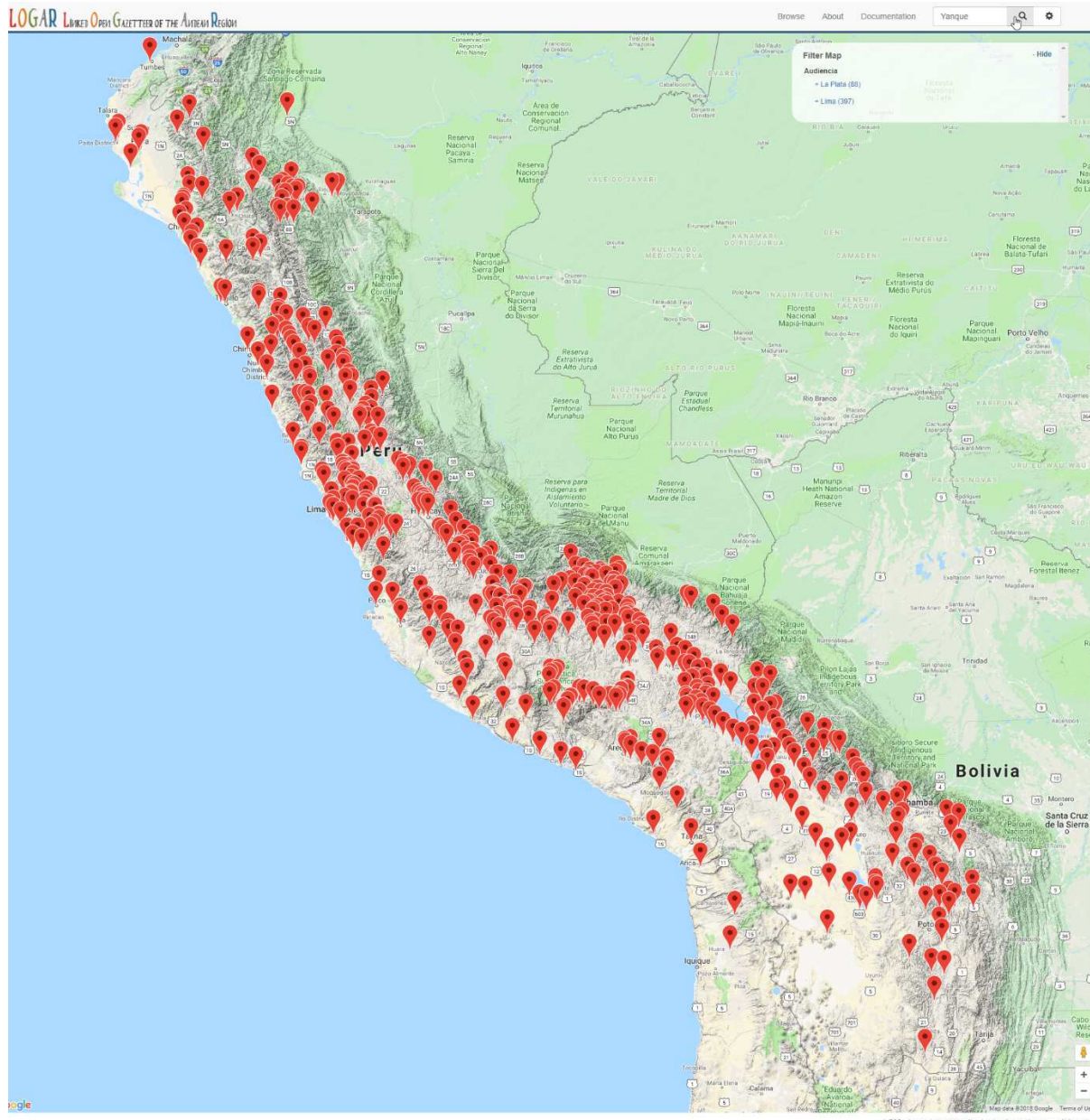


Figure 1. *LOGAR* map page, showing all 523 located *reducciones*, with keyword search (upper right corner, with magnifying glass icon) and hierarchical index (Filter Map box).

The compilation and review of this dataset was made possible by the interface and flexible TEI XML database of *LOGAR*. *LOGAR* was intended to overcome the technical barriers to integrating dispersed and fragmentary information and knowledge by providing a simple interface for place search and review via keyword search, alphabetical index, and map browsing. Much of our effort was focused on producing a user interface with minimal friction to finding and editing information in the gazetteer. In addition to map- and text-based searching, we wanted researchers to be able to “drill down” spatially by administrative jurisdictions, starting from the level of the viceroyalty down to the largest sub-viceroyalty division—the Audiencia—and from there down to the Corregimiento (Province), next to the level of the Repartimiento (a smaller jurisdictional unit of variable scope), by clicking the corresponding name of each jurisdiction in

a cascading hierarchy. The map to returns the corresponding reducciones within each jurisdiction. This functionality is illustrated in Figures 2-7.

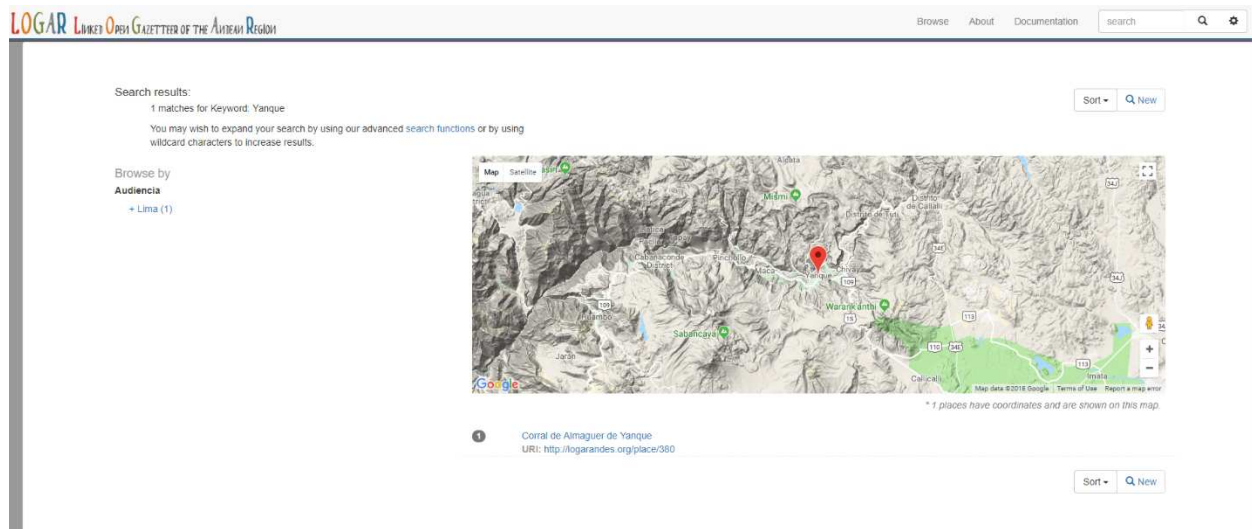



Figure 2. Search result for keyword "Yanque". The search result page provides links to the place page(s) of the search.

LOGAR Linked Open Gazetteer of the Andean Region

Browse About Documentation search

### Corral de Almaguer de Yanque

Download TEI/XML | Download RDF/XML | Download GeoJSON



Map data ©2018 Google, Terms of Use, Report a map error  
\* 1 places have coordinates and are shown on this map.

**Location**

- Ancient:**
  - Audiencia: Lima
  - Ciudad: Arequipa
  - Corregimiento: Collaguas
  - Repartimiento: Yanquecollagua yanquecollagua
  - Pueblo: Corral de Almaguer de Yanque
- Modern:**
  - Peru
  - Province: Caylloma
  - Department: Arequipa
  - Pueblo: Yanque
- Coordinates:**
  - Lat. -15.6494984°
  - Long. -71.85885624°
- Coordinates:**
  - 15 38 58.16200 -071 39 31.88860

**Names**

- Standardized: Corral de Almaguer de Yanque
- Standardized Spanish: Corral de
- Standardized Andean: Yanque
- Verbatim: corral de almaguer de yanque

Corrections/Additions? Comments

**Works Cited**

Any information without attribution has been created following the [Syntacta.org editorial guidelines](#).

- Levillier 1921-26 v8, pp. 174
- Levillier 1921-26 v8, pp. 174.
- AGI Lima 454

**How to Cite This Entry**

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**Bibliography:**

Steven A. Wernke and Jeremy Mumford, "Corral de Almaguer de Yanque." In LOGAR Linked Open Gazetteer of the Andean Region. Entry published May 9, 2016. LOGAR Linked Open Gazetteer of the Andean Region, edited by Steven A. Wernke and Akira Saito. <http://logarandes.org/place/390>.

**About this Entry**

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**Publication Date:** May 9, 2016

**Authorial and Editorial Responsibility:**


- Steven A. Wernke and Akira Saito, general editors, LOGAR Linked Open Gazetteer of the Andean Region

**Additional Credit:**

- Editing, proofreading, data entry and revision by Steven A. Wernke
- Editing, proofreading, data entry and revision by Jeremy Mumford

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[Hide citation](#)

Figure 3. Place page for the keyword search "Yanque", with Location (ancient and modern designations), coordinates, archival source information, and citation information. Background can be toggled to satellite image, with zoom and Google streetview functionality. Citation information includes all contributors to the place, including any corrections or additions. Place URIs are stable for long term reference.

LOGAR

LINKS OPEN GAZETTER OF THE ANTIAN REGION

[Browse](#)
[About](#)
[Documentation](#)

Browse Places

Title

Map

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P

Q

R

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ALL

A

1

2

3

4

Next

All

[Acar]

URI: <http://logarandes.org/place/357>

[Achaya7]

URI: <http://logarandes.org/place/350>

Acora

URI: <http://logarandes.org/place/519>

Alcantara de Callalla [Callalli]

URI: <http://logarandes.org/place/365>

Alcazar de Poata [Pocoata]

URI: <http://logarandes.org/place/462>

Almagro de Tomata

URI: <http://logarandes.org/place/494>

Almagro de Tomata

URI: <http://logarandes.org/place/488>

Ambana

URI: <http://logarandes.org/place/360>

Andamarca

URI: <http://logarandes.org/place/464>

Anocalla

URI: <http://logarandes.org/place/266>

Arabata

URI: <http://logarandes.org/place/469>

Aragua

URI: <http://logarandes.org/place/144>

Arapa

URI: <http://logarandes.org/place/342>

Aria Marcas [Pariamarca]

URI: <http://logarandes.org/place/138>

Asangaro

URI: <http://logarandes.org/place/332>

Asillo

URI: <http://logarandes.org/place/329>

Asuncion de Mito

URI: <http://logarandes.org/place/158>

Atca

URI: <http://logarandes.org/place/549>

Atico

URI: <http://logarandes.org/place/399>

Aucayania

URI: <http://logarandes.org/place/142>

Auquimaca

URI: <http://logarandes.org/place/122>

Ayaviri

URI: <http://logarandes.org/place/330>

Ayquile

URI: <http://logarandes.org/place/454>

Baeza de Chamaca

URI: <http://logarandes.org/place/302>

Bagua

URI: <http://logarandes.org/place/11>

1

2

3

4

Next

All

Feedback?

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Figure 4. LOGAR alphabetical index (page 1).

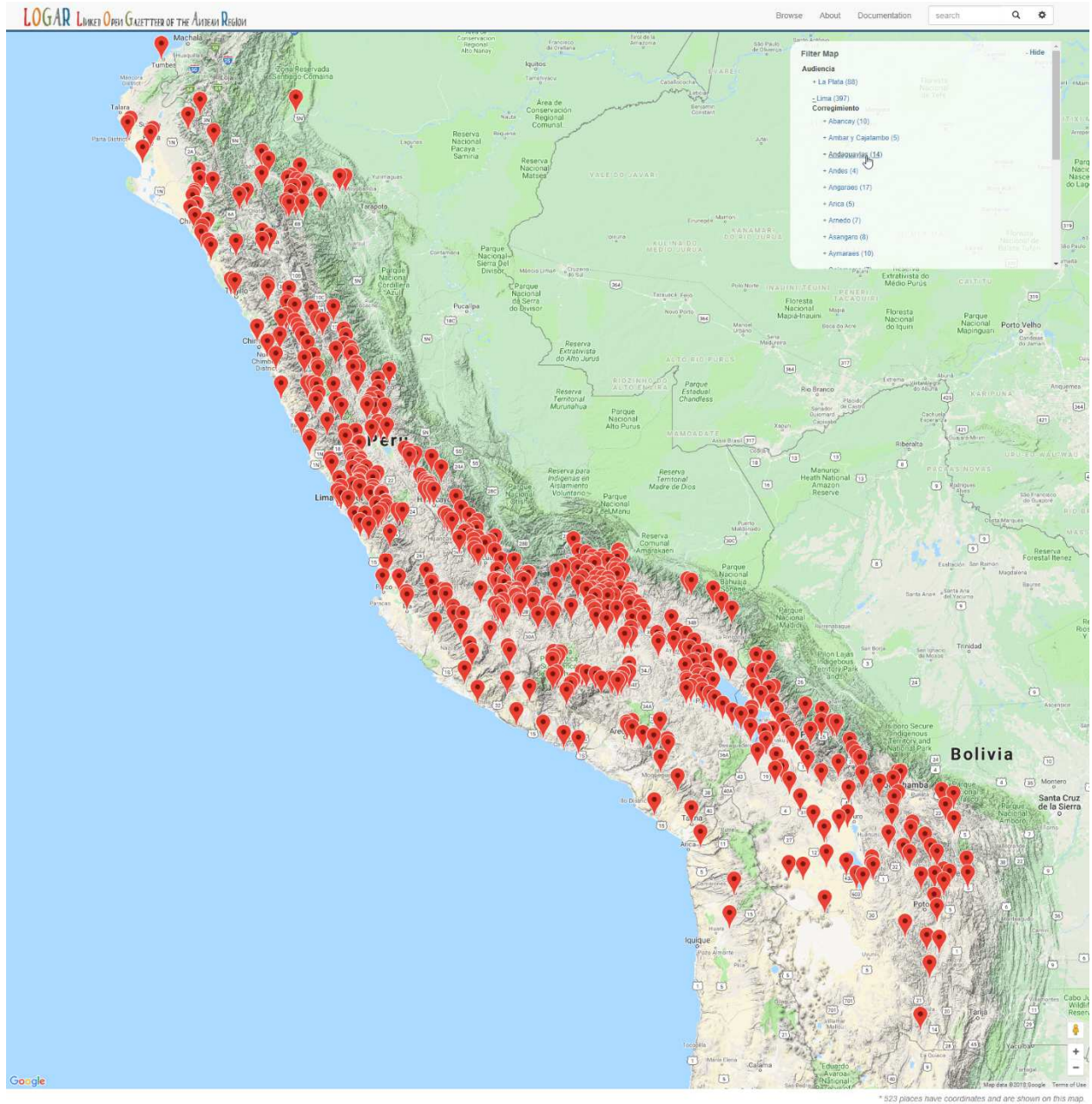


Figure 5. Interactive "drill down" functionality (upper right translucent box). Here, the user can drill down through a hierarchy of jurisdictional units starting with the largest jurisdiction--the Audiencia (Lima and La Plata)--then to the Corregimiento or Province, and finally to the Repartimiento (the minimal jurisdictional unit, composed of either a single village or small group of villages). Here, the user is selecting the Corregimiento of Andaguaylas (modern Andahuaylas) in the Audiencia of Lima. Clicking on Andahuaylas returns a map with the places located within that corregimiento (Figure 6).

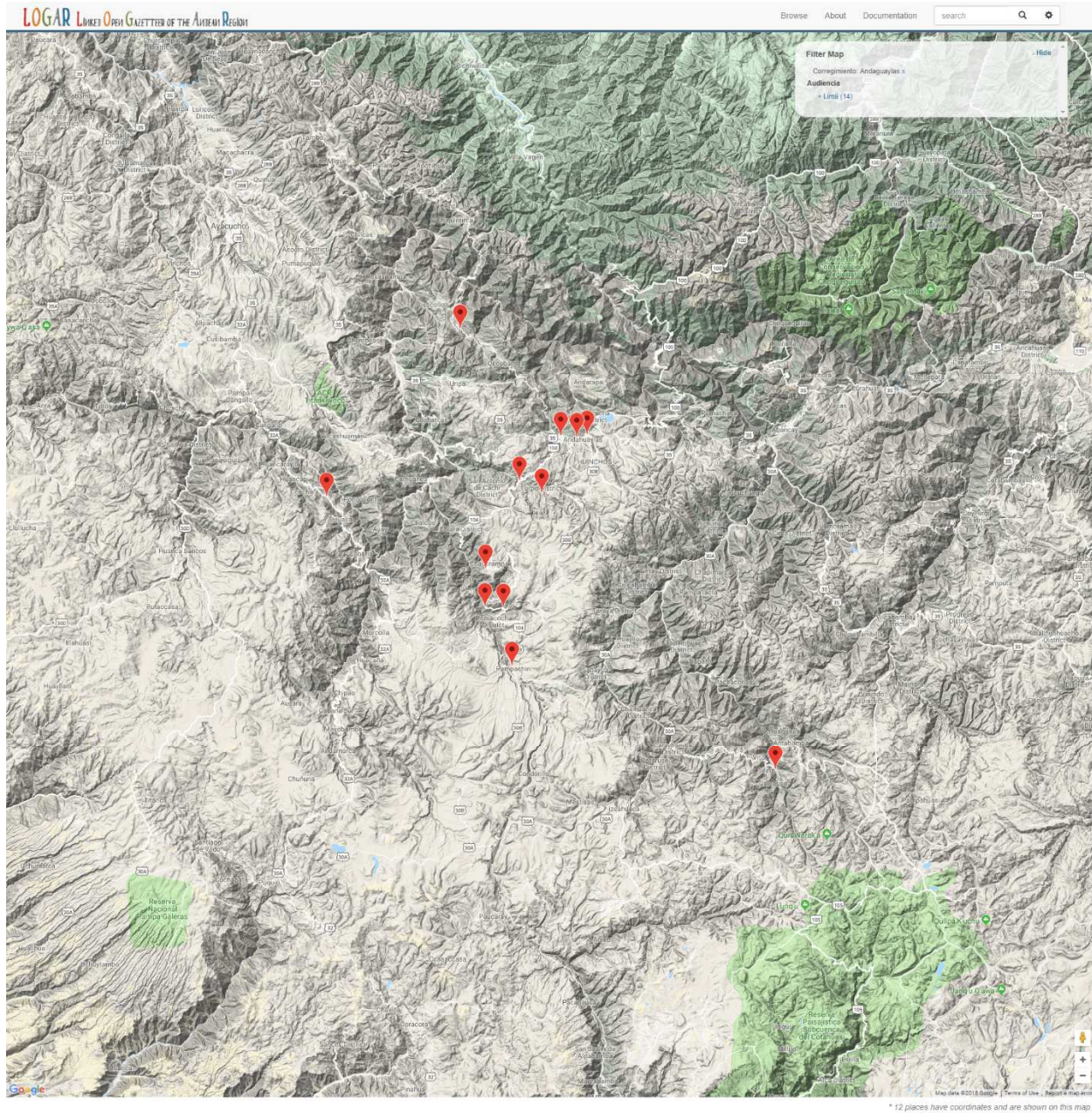


Figure 6. Example of second tier (Corregimiento level) in drill-down hierarchy: map of the Corregimiento of Andaguayas (as selected from drill down menu; see Figure 5) with reducción towns.

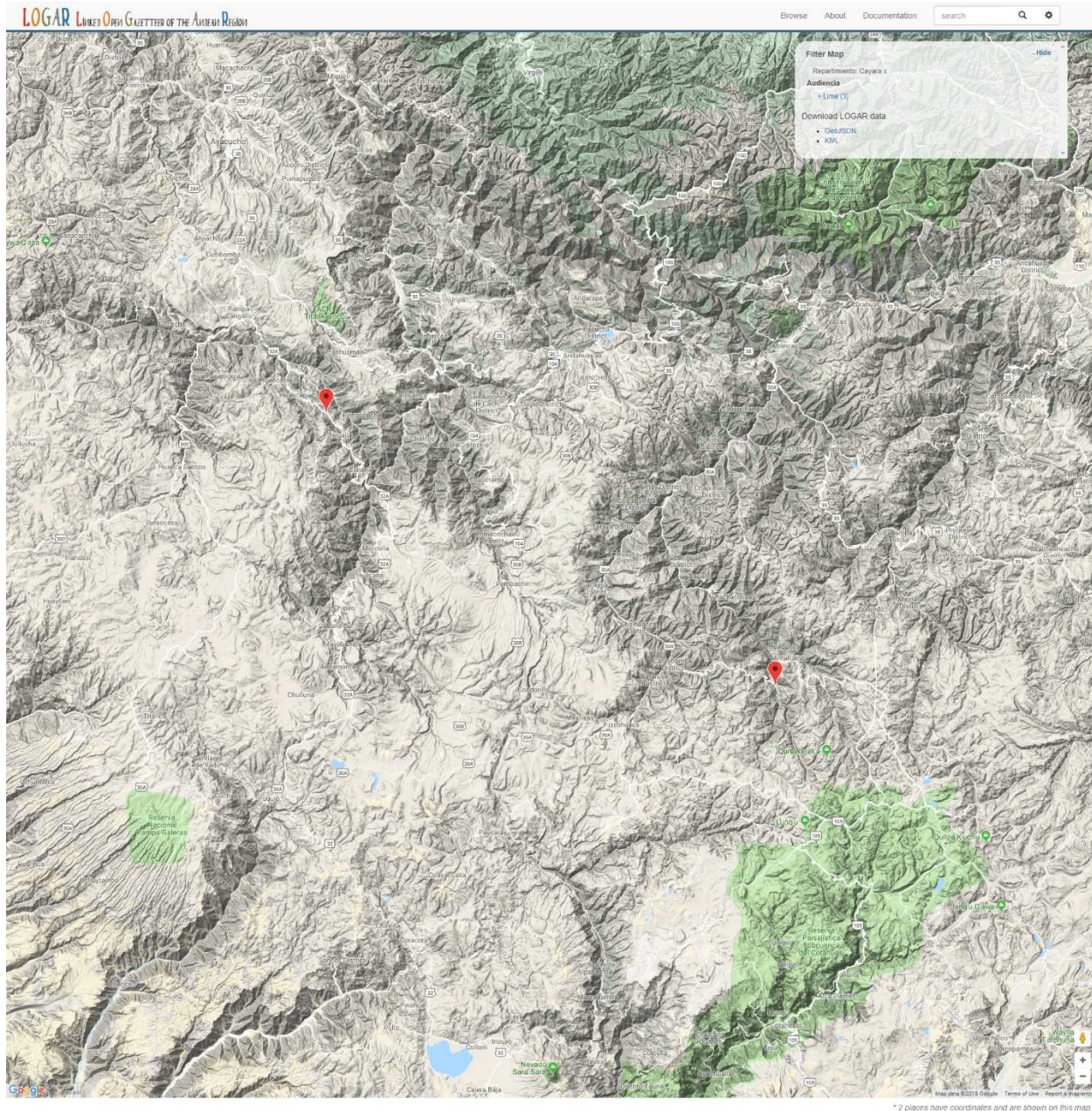


Figure 7. Example of third tier (Repartimiento level) in drill-down hierarchy: map of the Repartimiento of Cayares within the Corregimiento of Andahuaylas.

The utility of *LOGAR* also derives from its edited crowdsourcing functionality. Users can contribute new places or submit corrections or additional source information about existing places in the gazetteer through a Corrections/additions link on each place page. From there the user fills out a field-based form for editorial review. *LOGAR* also enables input of new places and correction or additional information on extant places in the database, via simple form-based input fields (Figures 8-11). A general additions/comments/corrections form is also linked for each place (Figure 12). Additions and corrections are submitted to an editorial backend that enables review of submissions by the editors. Submissions are reviewed for accuracy, standardization for ingest to the database, and attribution (citation) for the submitter before commit to the canonical database. In this way, all data visible on *LOGAR* has undergone editorial

review. At present only the general editors are performing these tasks. As submission volume increases, or as area-specific questions arise, we will recruit regional editors. This two-tiered editorial model was part of the original design envisioned in the project proposal.

The screenshot shows a web interface titled "Corrections/Additions?". It features a "User Details" section with fields for "Your Name:" and "Your email:", and a large text area for "Comments about suggested changes/additions:". Below this is a "Record ID" section showing "http://logarandes.org/place/421/tei". The main section is titled "Names of Place" and includes an "Instructions" button. A yellow box contains instructions on how to add or change place names. Below the instructions are three input fields for "Name", each with a "New Source" button and a "Source" button. The first field contains "la Puente del Arzobispo", the second "la Puente de", and the third "la Puente del arzobispo".

Figure 8. Corrections/Additions tab 1: User information page and Name of Place correction/edit form.

The screenshot shows the "Corrections/Additions" tab with the "Descriptions" section selected. It includes the same "User Details" and "Record ID" sections as Figure 8. The "Names of Place" section is now titled "Descriptions" and features a "New Description" button. Below this is a large text area for adding a new description. At the bottom of the page, there are "Submit" and "Download XML" buttons. A small text area at the bottom left contains technical details about the form submission process.

Figure 9. Corrections/Additions page, Description tab.

Corrections/Additions?

User Details

Your Name:

Your email:

Comments about suggested changes/additions:

Record ID: <http://logarandes.org/place/421/tei>

Names of Place

Descriptions

Locations

Sources

Locations

Instructions

If the current location is erroneous, or if the place has moved over time and you know a different location from the one provided, then

1. click add coordinates and enter the coordinates as decimal degrees or as degrees, minutes seconds. Coordinates can be derived from Google Earth or Google Maps, for example.
2. Indicate the source of your location information (both the coordinate source and the information source for the place). Select from the dropdown menu.
3. If your location information derives from a source not listed in the dropdown menu, click New Source and enter the citation information (we will standardize the information, but be as complete as possible).
4. Select the new source you just added from the dropdown menu.
5. Click submit.

Coordinates

Coordinates

Add Coordinates

Add Location Description

Figure 10. Corrections/Additions page, Locations tab.

Corrections/Additions?

User Details

Your Name:

Your email:

Comments about suggested changes/additions:

Record ID: <http://logarandes.org/place/421/tei>

Names of Place

Descriptions

Locations

Sources

Sources

Instructions

If you would like to add an information source (e.g. an archival document, a published document, an ethnographic citation), then simply click New Source and add the citation information. We will standardize the information, but be as complete as possible.

Title:

Title:

Title:

New Source

2 -> Dispatching event xfoms-submit on <SPAN class="xfoms-submission" id="y-get-rec">

12 -> Submit get - application/xml - services/get-rec.xq?d=http://logarandes.org/place/421 - true

140 -> Dispatching event xfoms-rebuild on <SPAN class="xfoms-model" id="m-place">

6 -> Dispatching event xfoms-rebuild on <SPAN class="xfoms-model" id="m-place">

Submit

Download XML

Figure 11. Corrections/Additions page, Sources tab.

Corrections/Additions?
X

Notify the editors of a mistake:
[more information...](#)

Name

email

subject

Comments

Close

Send e-mail

Figure 12. General comments/corrections page.

Equally importantly, place data can be downloaded as Atom XML, GeoJSON, or KML files for use in desktop GIS, database, and statistical programs. Users can download the place data and view/analyze, manipulate them in the application of their choice (Figure 13).

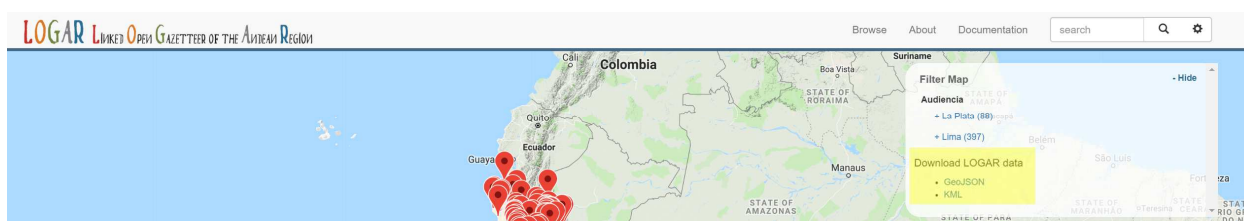


Figure 13. Download *LOGAR* data link (upper right [highlighted] below drill down menu).

### *GeoPACHA accomplishments*

This project also produced *GeoPACHA*, a fully functional browser-based virtual archaeological survey tool. *GeoPACHA* enables not only review but creation and editing of GIS-based features and attributes (stored in Spatialite format). As the discovery instrument complement to *LOGAR*, *GeoPACHA* was intended to enable users to visually scan high resolution satellite imagery (via Google Map satellite API), place newly identified reducciones and other sites on the map, and fill out corresponding observational (attribute) data. As such, *GeoPACHA* acts as the discovery instrument for identifying abandoned reducción towns. Once identified and located (with coordinates), they can be added to *LOGAR*.

For the end user, *GeoPACHA* presents a login/registration page, followed by a home page with all currently located sites and the user UI (Figures 14-15). The interface includes a 2x2 grid for tracking survey coverage (Figure 16). The user zooms into a 2x2 km grid cell, then zooms into the scale of one quadrant of the cell (1x1 km approximately) and visually scans each of the four quadrants within the cell. If a site is identified, a point is placed in its approximate center, creating a point vector feature, and an attribution data entry form appears (Figure 17). The user first indicates whether the site identified has distinctive Spanish colonial era features (thus categorized as “Colonial Site”) or if it is from another time period (in this iteration, all non-Colonial era sites are categorized as “Points of Interest”; in the implementation phase, this catchall will be disaggregated). The interface includes distance and area measurement tools to enable registry of quantitative measures (Figure 18). In addition to site area, attribute fields include a confidence ranking of the site identification (on a five-point interval scale), observations on its occupational status (presently occupied, partially abandoned, entirely abandoned), the presence of looting, and general notes. After a survey grid cell is surveyed, its attribute form is marked as completed as a means of tracking survey coverage.

Like *LOGAR*, *GeoPACHA* is organized as a tiered, edited database to facilitate data quality assurance. All sites identified by users are binned for review by editors before commitment to the canonical database. Users with editor-level permission also access to the editorial review backend (Figure 19). This interface enables editors to accept, reject, or edit the locational or attribute data of each identified site before commitment to the database. The underlying spatialite database includes full version control.

At this startup phase, *GeoPACHA* was used by the Wernke and VanValkenburgh largely for test purposes. However, it is a fully functional platform, and it will be instrumental in providing full documentation of previously unknown, abandoned reducciones during the implementation phase (ACLS digital extension grant awarded, to begin, 12/2018; NEH ODH Level III Digital Humanities Grant in review).

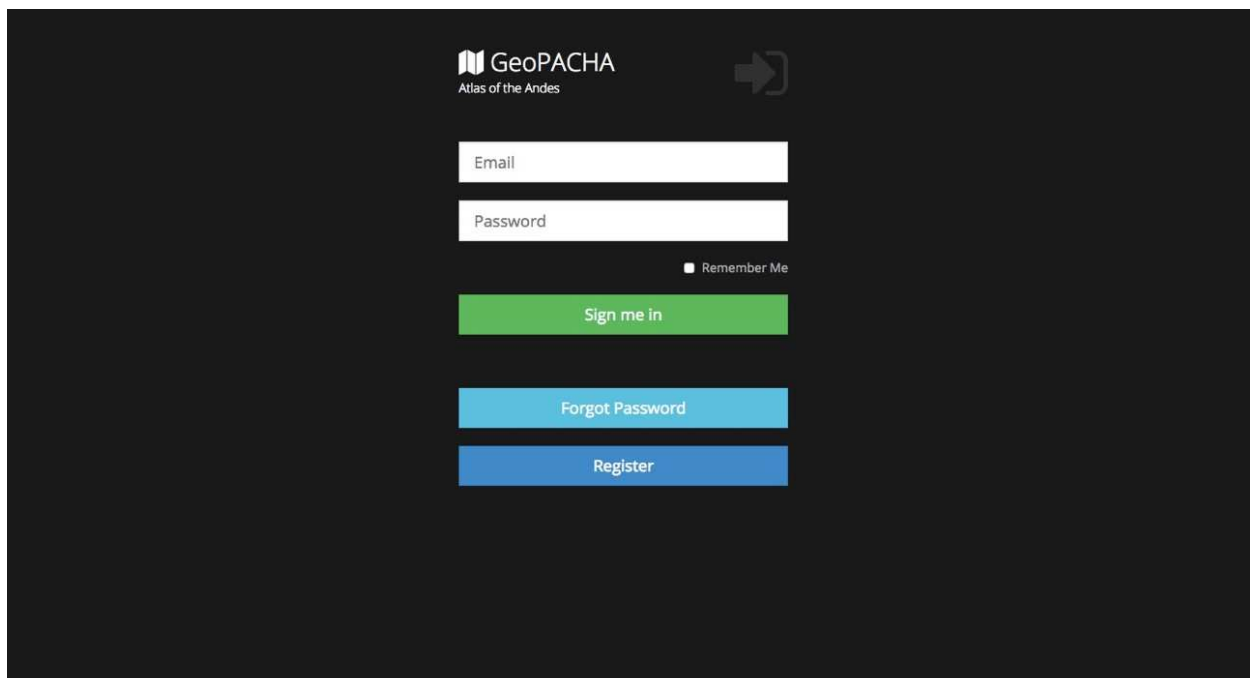


Figure 14. Landing page of *GeoPACHA*. User login/registration page.



Figure 15. *GeoPACHA* home page, showing user interface, map contents (toggle function to turn on/off each layer)

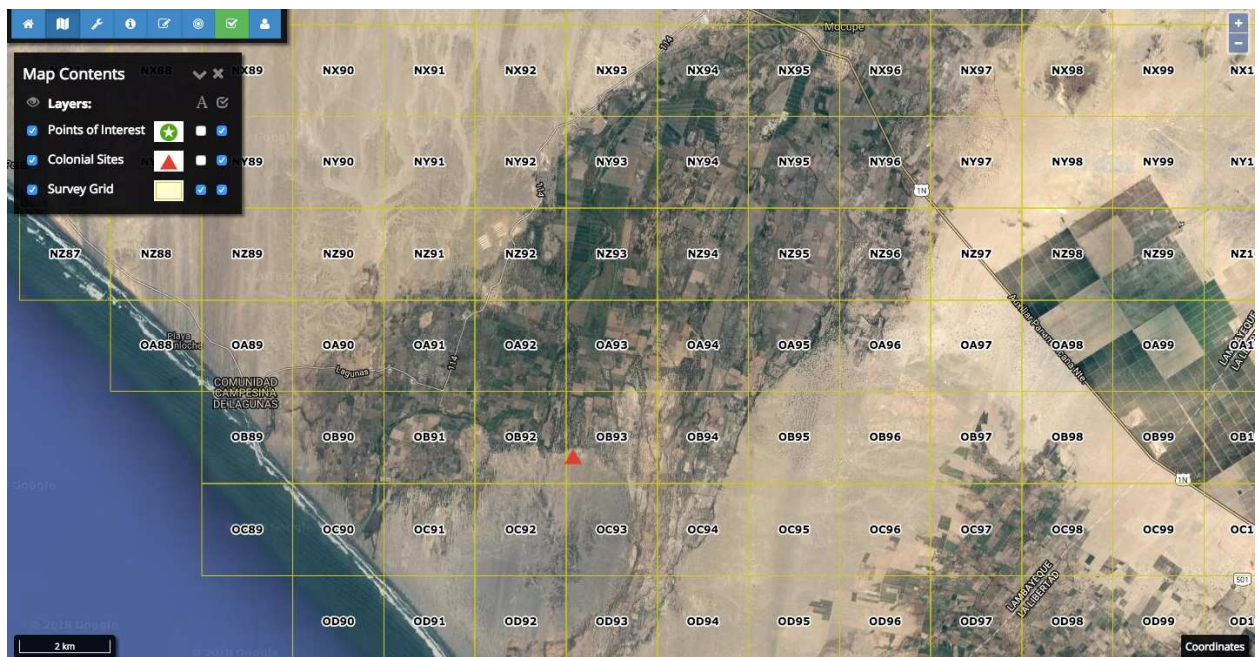


Figure 16. 2x2 km survey coverage monitoring grid.

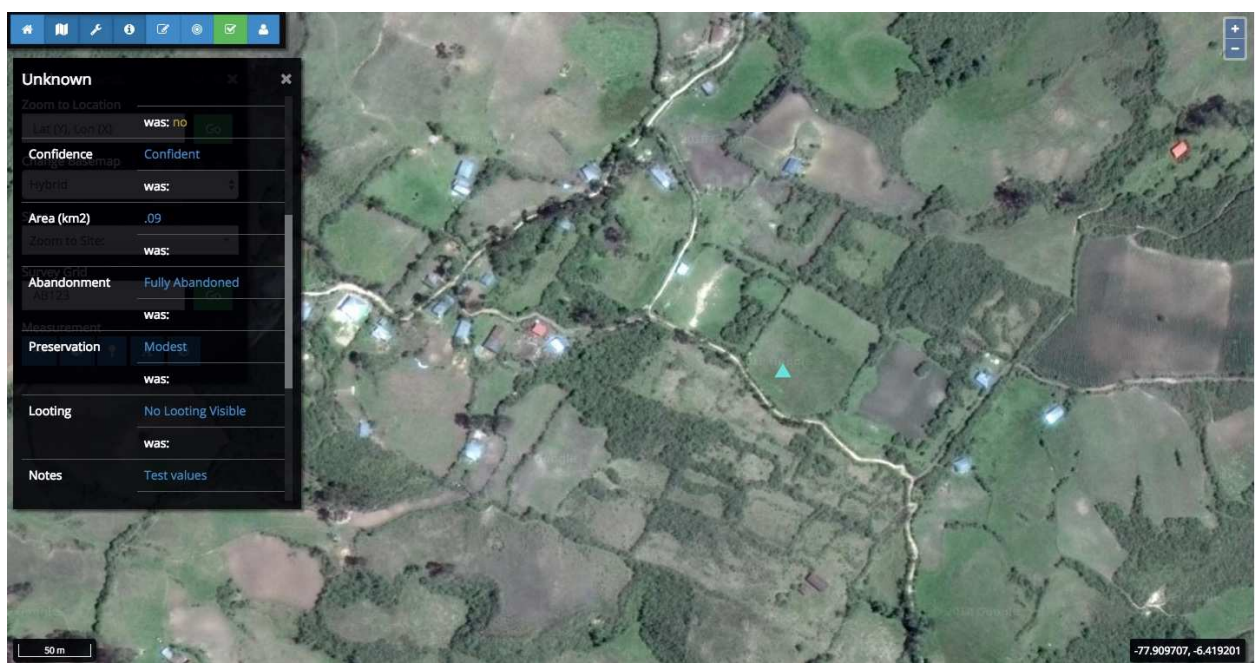


Figure 17. Virtual survey interface of *GeoPACHA*, showing the attribute data entry form that pops up upon placing a site point (triangle icon, center).



Figure 18. Area measurement tool.

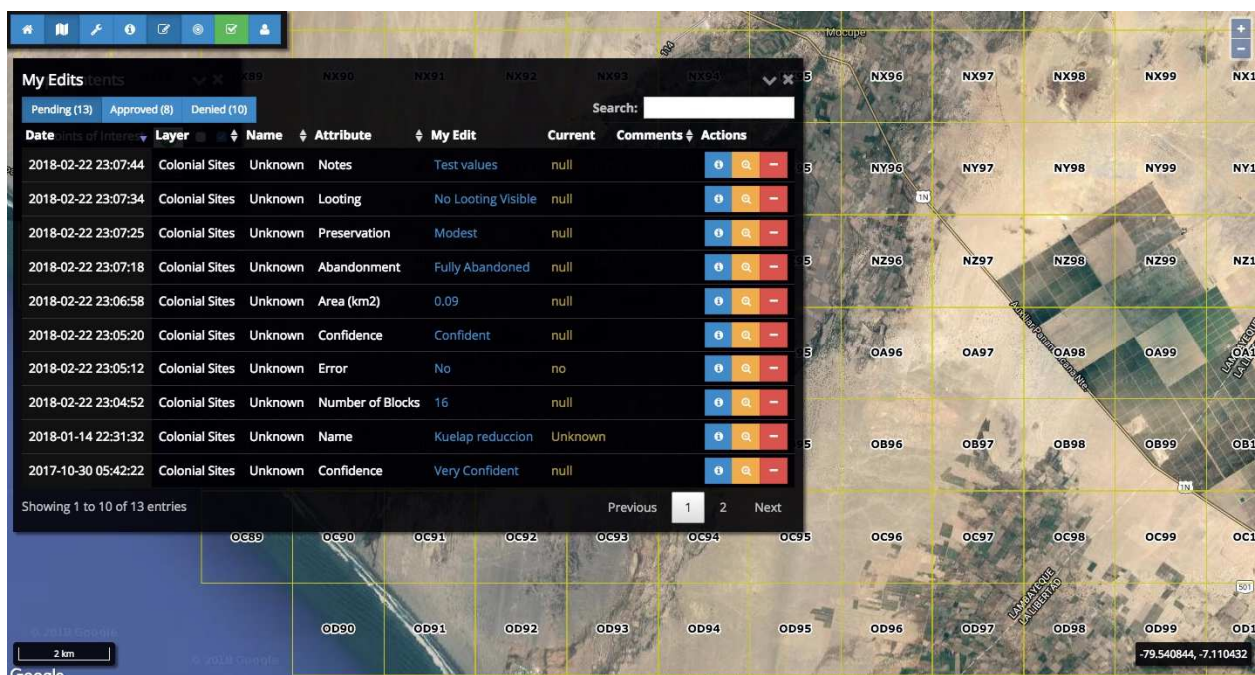


Figure 19. Editorial review interface.

**c. Audiences**

Substantively, *LOGAR* and *GeoPACHA* are of broad research interest to humanists and social scientists of the Andean region working in a variety of disciplines, especially anthropology, archaeology, history, and geography. More broadly, *LOGAR* and *GeoPACHA* address fundamental problems that scholars of antiquity face: the problems of disperse and fragmentary primary source information, limited field-based archaeological research, and technical barriers to integrating them. As such, *LOGAR* and *GeoPACHA* can serve directly as a model for projects in other geographic and historical contexts (indeed, as the Syriac Gazetteer and the CORONA Atlas have for *LOGAR* and *GeoPACHA*, respectively).

**d. Evaluation**

Not applicable. No evaluation was performed.

**e. Continuation of the Project**

Both *LOGAR* and *GeoPACHA* remain in active development. Both build on a foundation of strong institutional support, infrastructure, and expertise. The P.I. is founding director of the Vanderbilt University Spatial Analysis Research Laboratory (SARL), an advanced geospatial analytical facility, which will host the project (including a graduate student laboratory manager), with guidance and support from technical advisors at Vanderbilt.

Continuing *LOGAR* development is funded by the Chancellor's Faculty Fellowship (Wernke), Wernke's startup funds, and Saito's Japan Society for The Promotion of Science Grant. With this strong foundation, we are now working towards integrating the other three manuscript versions of the *tasa*, and the incorporation of crowd-sourced contributions on a place-by-place basis, largely through a large and expanding network of collaborating scholars (a now well-acquainted community through the three symposia hosted over the course of the project, as discussed in Project Activities above). *LOGAR* has already established the most comprehensive basemap of the settlement system of the Viceroyalty of Peru. From here, we seek to extend its coverage both spatially and chronologically to incorporate missing *reducciones* (through discovery via *GeoPACHA*), and subsequently to include other kinds of places from the colonial Andes. The General Resettlement set off a flurry of unintended consequences, including second- and third-waves of resettlement, as displacement proved too disruptive for many indigenous communities, and new villages were established through the sixteenth through nineteenth centuries.

*GeoPACHA* is also under active development, and we are now planning a major push for expansion of its capabilities with the support of an ACLS Digital Extension Grant. This grant will enable the development of significant new functionality to *GeoPACHA* in five areas: 1) integrating and sharing more satellite imagery and historical airphotos; 2) survey coverage monitoring; 3) ingesting extant datasets from previous archaeological surveys, 4) new attribute forms and metadata management, 5) new data sharing functionality. Lastly, the grant directly funds the virtual survey itself, divided among six survey areas in the central Andes, totaling 140,000 square kilometers. Our NEH ODH Level III Digital Humanities Advancement Grant proposal is in review. If funded, that grant would enable full implementation and expansion of these activities.

This project and SARL also count on long-term institutional support from Vanderbilt. Wernke is on the founding steering committee for the Vanderbilt's recently-opened Center for Digital Humanities, as well as the steering committee for the university-wide Data Science

initiative. Dr. VanValkenburgh directs the Digital Archaeology Laboratory at Brown University and is a faculty associate of the Spatial Structures in the Social Sciences (S4) program, which will provide additional support for *GeoPACHA*.

**f. Long Term Impact**

Ultimately, we see *LOGAR* as a more general repository and reference work for the colonial Andes, with information collated by place (whether located or unlocated). With the platform in place, the power of *LOGAR* will derive from the strength and diversity of the contributions of this community and we are confident that it will grow to become such a repository. In a similar fashion, we see *GeoPACHA* as a generalizable platform for virtual archaeological survey in the Andean region. During the next implementation phase, *GeoPACHA* will curate legacy datasets from archaeological field surveys (which will in turn serve as validation data [ground truth] for evaluating virtual survey data results), as well as large area orthomosaics (photogrammetrically processed) of historical aerial imagery from as far back as the 1930s (thus enabling detection of sites no longer visible or destroyed due to modern development and/or looting). The implementation project acts not only as a generator of vital datasets in its own right, but also as a necessary step toward our planned development of automated, deep machine learning approaches to mass-scale archaeological prospection, by producing high quality training data. That project will develop in parallel with future ingestion of legacy datasets as *GeoPACHA* becomes a key repository for Andean archaeology. Thus, future iterations flow directly from this implementation, and we see clear paths to major funding through institutions such as NEH, NSF, ACLS, NGS, Wenner-Gren, the Mellon Foundation, and a variety of intramural funding sources.

**g. Grant Products**

In addition to *LOGAR* and *GeoPACHA* themselves, this project resulted in the following presentations and grants:

*Invited Presentations*

- |      |  |
|------|--|
| 2017 | “Remote Sensing in Archaeology: Toward Automated Approaches,” by Steven A. Wernke, Gabriela Oré, and James Zimmer Dauphinee,” presentation for Data Science Think Tank series, Data Science Visions Trans-Institutional Program, Vanderbilt University.  |
| 2017 | “Bound together, torn apart: a spatial archaeology and microhistory of forced resettlement in the colonial Andes.” Keynote lecture, 57 <sup>th</sup> Annual Meeting of the Institute of Andean Studies, University of California, Berkeley. Video: <a href="https://drive.google.com/file/d/0Bx6OoayV6rpVLXdLRU5lVjVrUXc/view">https://drive.google.com/file/d/0Bx6OoayV6rpVLXdLRU5lVjVrUXc/view</a> |
| 2017 | “Spatial Humanities: Linking Scales, Research, and Learning,” by Steven A. Wernke, Scotti Norman, and Cole Carlin. Presentation to the Vanderbilt University Board of Trust, November, 2017.   |
| 2017 | “Big Spatial Data Analysis at SARL.” Poster presented to the Vanderbilt University Board of Trust, April 20, 2017.   |
| 2016 | “ <i>LOGAR</i> y <i>GeoPACHA</i> : avances en el desarrollo de herramientas digitales colaborativas para la investigación del mundo andino colonial”, by Steven A. Wernke and Parker VanValkenburgh. Paper presented at the international  |

- 2016 symposium *Las reducciones toledanas en perspectiva comparativa y multidisciplinaria*, organized by Akira Saito, National Museum of Deep Mapping the Reducción: Building Digital Humanities Collaborative Tools for Mapping the General Resettlement of Indians in the Viceroyalty of Peru,” by Steven A. Wernke and Jeremy R. Mumford. Invited lecture presented at the Research Institute for Humanity and Nature, Kyoto, Japan.

#### *Conference Presentations*

- 2015 “Deep Mapping the Reducción: Building a Platform for Spatial Humanities Collaboration on the General Resettlement of Indians in the Viceroyalty of Peru,” by Steven A. Wernke and Jeremy Ravi Mumford. Paper presented at the international symposium Rethinking Forced Resettlement in the Colonial Andes, organized by Akira Saito and Steven A. Wernke, sponsored by the National Museum of Ethnology, Japan, hosted by Vanderbilt University (November 6-8, 2015).
- 2015 “Deep Mapping the Reducción: Building a Platform for Spatial Humanities Collaboration on the General Resettlement of Indians in the Viceroyalty of Peru,” by Steven A. Wernke and Jeremy Ravi Mumford. National Endowment for the Humanities Office of Digital Humanities Directors Meeting, Washington DC.

#### *Related Grants*

- 2018-present American Council of Learned Societies Digital Extension Grant: Extending *GeoPACHA*: Geospatial Platform for Andean Culture, History, and Archaeology. Steven A. Wernke, PI.
- 2017-present Vanderbilt University Trans-Institutional Programs: VUSAT: Vanderbilt University Satellite Initiative. Amrutur Anilkumar, PI, Steven A. Wernke, Co-PI, Ralf Bennartz, Co-PI.
- 2016-present Center for Advanced Spatial Technology (CAST) Spatial Archaeometry Research Collaborations (SPARC) grant: Developing *GeoPACHA: Geospatial Platform for Andean Culture, History, and Archaeology*. Steven A. Wernke, P.I., Parker VanValkenburgh, co-PI. SPARC is an NSF-funded grant program administered by CAST.
- 2016-present Chancellor Faculty Fellowship. <http://www.vanderbilt.edu/strategicplan/trans-institutional-programs/cff2016.php>
- 2016-present Mellon Faculty Fellowship in Digital Humanities, Vanderbilt Center for Digital Humanities. *Implementing GeoPACHA: Geospatial Platform for Andean Culture, History, and Archaeology*.

#### *Publications*

The project will also produce a number of publications. Most directly, our symposia series continues this summer (July, 2018) with a double session at the Congress of Americanists in Salamanca, Spain. Participants in that session include presenters from the previous three volumes. The objective of the session is to present the final versions of chapter manuscripts for an edited volume (to be edited by Saito and Wernke) on a U.S. academic press on the General

Resettlement. Wernke, Mumford, VanValkenburgh, and Saito will include a chapter on the progress and prospect, as well as analytical findings, of *LOGAR* and *GeoPACHA* in that volume. Wernke and VanValkenburgh were also invited by Lynn Goldstein and Ethan Watrall to prepare a chapter manuscript for a forthcoming volume entitled *Digital Heritage & Archaeology in Practice*. We intend present the framework of *GeoPACHA* and present a case study for that volume, which is slated for publication in 2019.

***h. Appendices***

None